An "Mushroom Recognition System" based on Matlab and QuickCog

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Overview

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Motivation

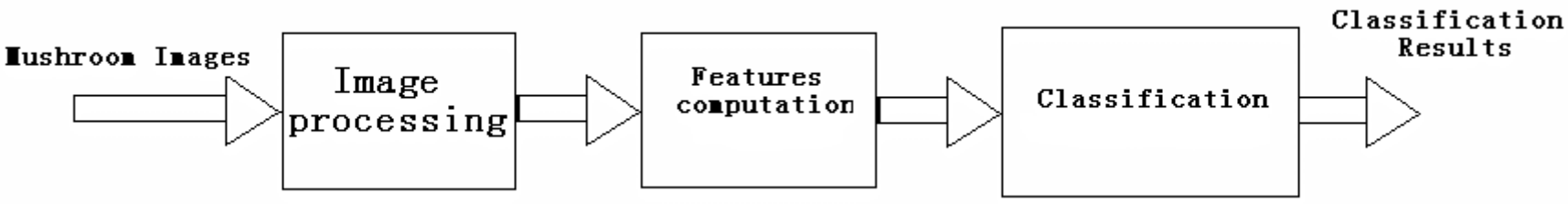
Mushroom is one of popular food in human's life, so it is significant t
sort them from edible and poisoning. For this purposes, a recognition
system is necessarily needed.

Edible

poisoning

Parts of Project

- For this useful and realistic application. Mushroom recognition system based on the imaging processing, Matlab and Quickcog is realized.
- The project can be specified by the block structure below. They are ‘Image processing’, ‘Features computation (Matlab or Quickong)’, Classification (Quickcog)’ individually.



1. Image Processing

- The original mushroom images are divided into two sets: e-dible or poisoning (shown in next page).

- The background of the original mushroom image

  It must be taken away to reduce the effective to the classification results

- A Tool used for erasing backgrounds

  Image processing software: NEO IMAGING

1. Image Processing

- Edible mushroom of training data

- Poisoning mushroom of training data

1. Image Processing

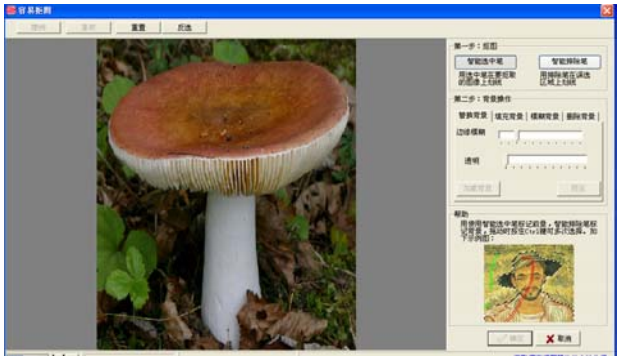
- Edible mushroom of test data

- Poisoning mushroom of test data

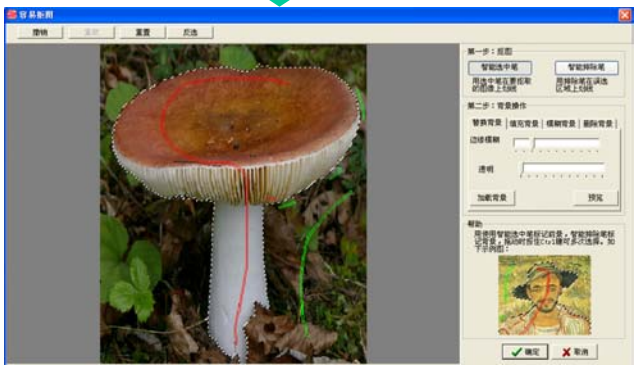
Image Processing

- Erasing backgrounds

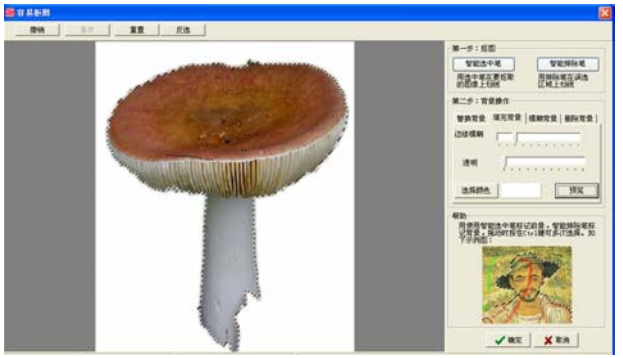
Using the tool: ‘Erasing’ in the software, the backgrounds can be easily get rid of from the images.



Original images



- The red line: selecting area
- The green line: erasing area



The result after erasing background

1. Image Processing

- Images after image processing: edible

Cap

Cap and body

1. Image Processing

- Images after image processing: poisoning

Cap

Cap and body

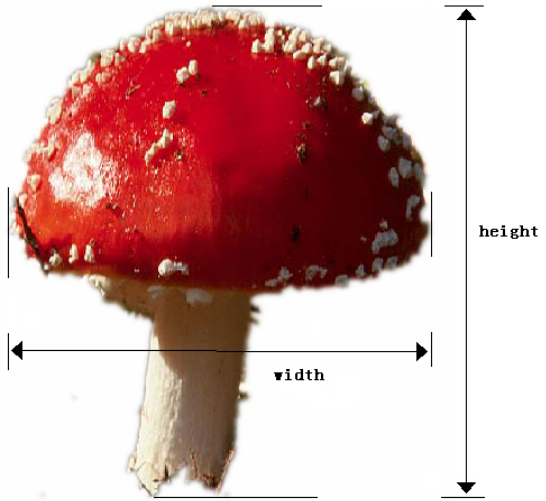
1. Image Processing

- Images after image processing: test data

2. Feature Computation

- The color information (RGB) of the cap is taken into account as well as the ratio between height and width of the mushroom.

Color on the cap



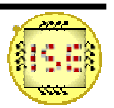
Ratio between height and width

- Without the effective of the backgrounds, these two features are easy to obtain. The programs (Matlab C) computing them a-re shortly shown in the next pages. A feature vector of each mu-shroom is finally got with the form of [R G B Ratio].

2. Feature Computation

- Part program of feature computation: Color

```
function [Color] = RGBExtract(IM)
.....................................
    for i =1:row
        for j =1:column
            if  IM(i,j,1) < 254 | IM(i,j,2) < 254 | IM(i,j,3)<254
              Length = Length + 1;
              R(Length) = IM(i,j,1);
              G(Length) = IM(i,j,2);
              B(Length) = IM(i,j,3);
            end
        end
    end
.....................................
    Color = [Red Green Blue]
```

2. Feature Computation

- Part program of feature computation: Ratio

```
function [Ratio] = measurement(IM)
……..
 for i = 1:row
  for j = 1:column
   if IM(i,j,1)<254|IM(i,j,2)<254|IM(i,j,3)<254
        n = n +1;
       A(n) = i;
       B(n) = j; break
       break
……
    x1 = max(A);
    x2 = min(A);
    height = x1-x2 + 1;
    x3 = min(B);
……
```

```
……
for i = 1:row
  for j = column:-1:1
   if IM(i,j,1)<254|IM(i,j,2)<254|IM(i,j,3)<254
       m =m+1;
       C(m) =j;

……..
        x4=max(C);
  width = x4-x3-1;

  Ratio = width/height;
```

2. Feature Computation

- Result of feature computation

  Mushroom features: [R G B Ratio]

edible_1	142.7194	91.3568	59.1124	0.8276
edible_2	174.2356	164.0360	146.5751	0.7054
edible_3	143.8243	93.9227	57.6074	0.8130
edible_4	197.9806	158.7962	108.4971	0.7886
edible_5	200.7127	145.7325	96.2573	0.8829
poisoning_1	228.0304	131.1858	87.5613	0.8312
poisoning_2	173.4778	118.3317	116.3756	0.6708
poisoning_3	223.9477	143.2615	121.7681	0.9015
poisoning_4	188.2277	177.3115	145.0212	0.6407
poisoning_5	159.9909	57.5071	58.5356	0.861

2. Feature Computation

- Result of feature computation

  Test data features: [R G B Ratio]

edible_test_1	142.7194	91.3568	59.1124	0.8276
edible_test_2	204.5591	153.5135	110.8948	0.6129
Poisoning_test_1	161.9237	103.2491	93.7335	0.8110
Poisoning_test_2	173.4778	118.3317	116.3756	0.6708

3. Classification

- After feature computation, a classification system (train and test) based on Quickog is established and shown in the following pages

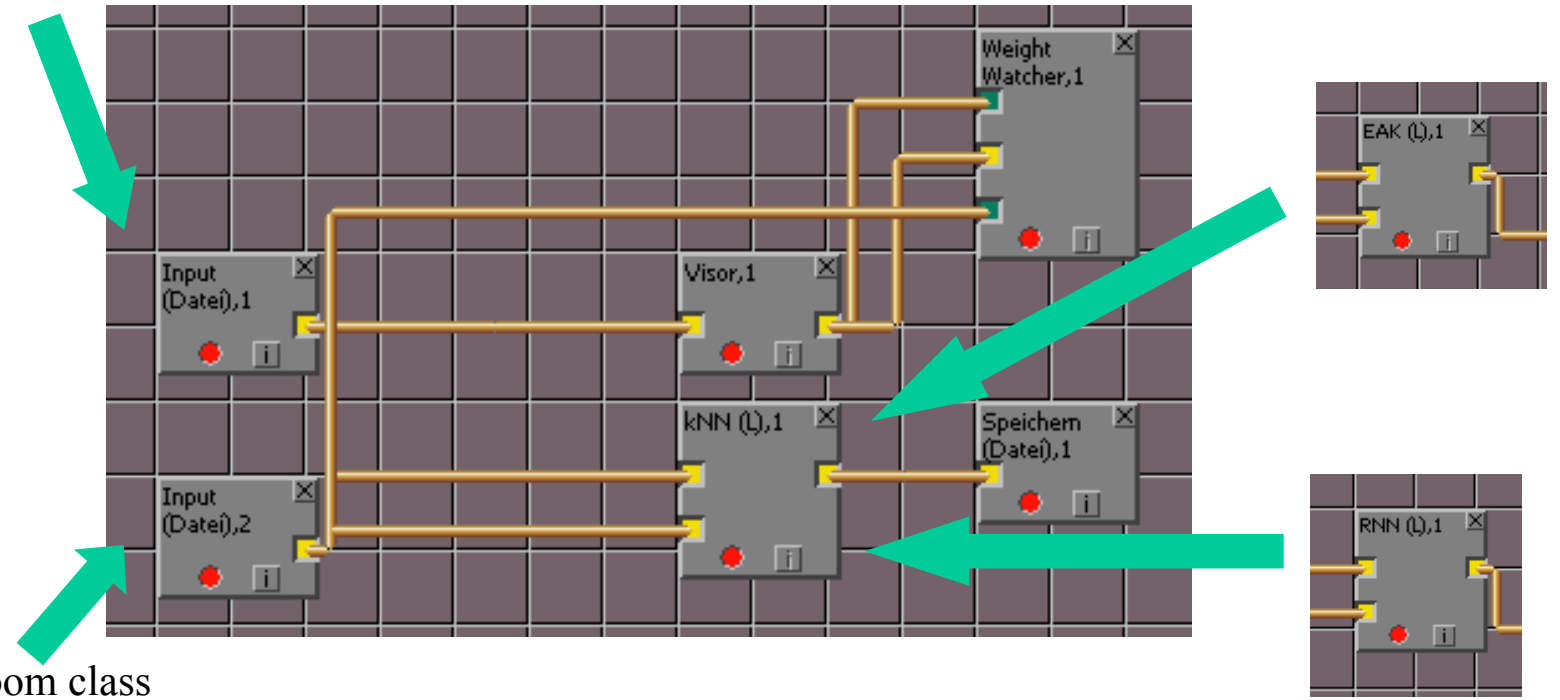
- Systems without and with features reduction are discussed individually.

- Different classification methods are used: KNN, RNN, and Eucledian Distance Clasifier (EAK).

3. Classification

Train system without feature reduction

Mushroom features from Matlab



Mushroom class

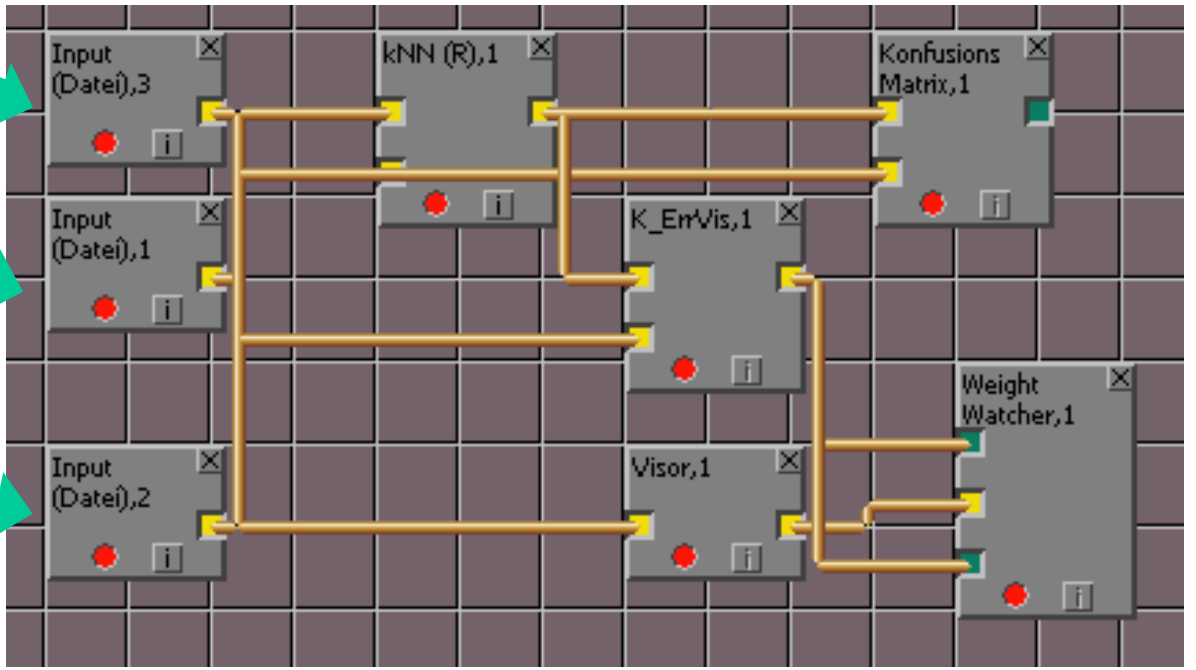
3. Classification

Test system without feature reduction

Training results

Mushroom features for test

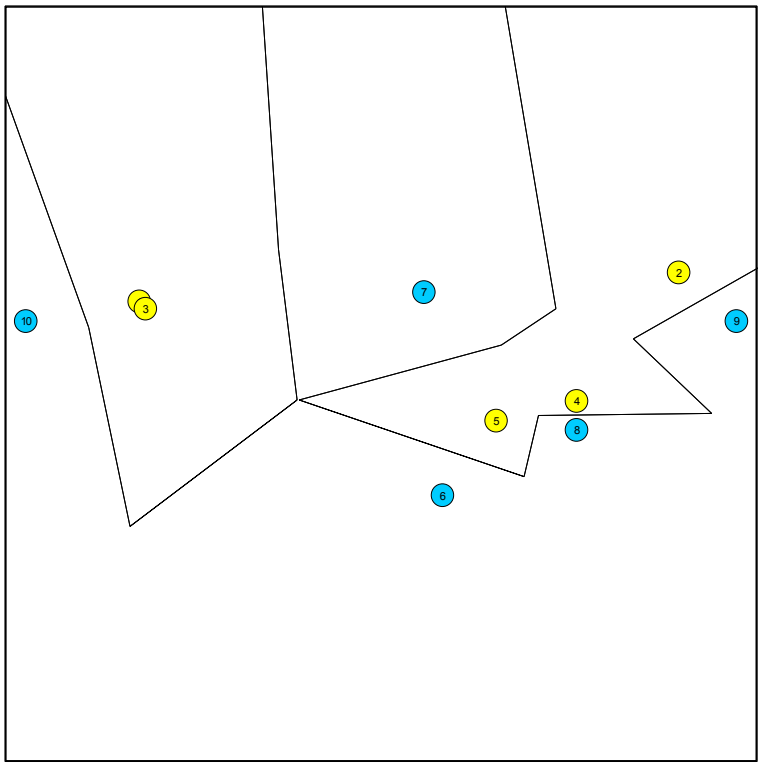
Test mushroom class



3. Classification

- Classification results: KNN, RNN, EAK

Visualization of train data



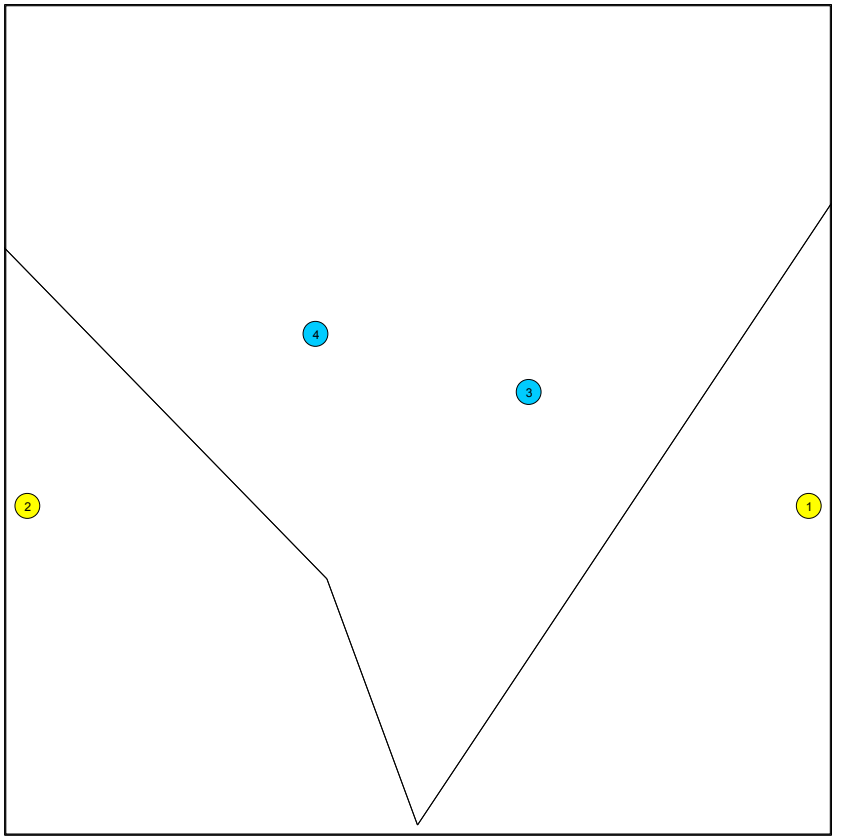
3. Classification

- Classification results: KNN, RNN

Test result:

Klasse1 (2): 0 (R) 100 0
Klasse2 (2): 0 (R) 0 100

Erkennungsrate: 100.000 %
keine Fehler, 0 Warnung(en)



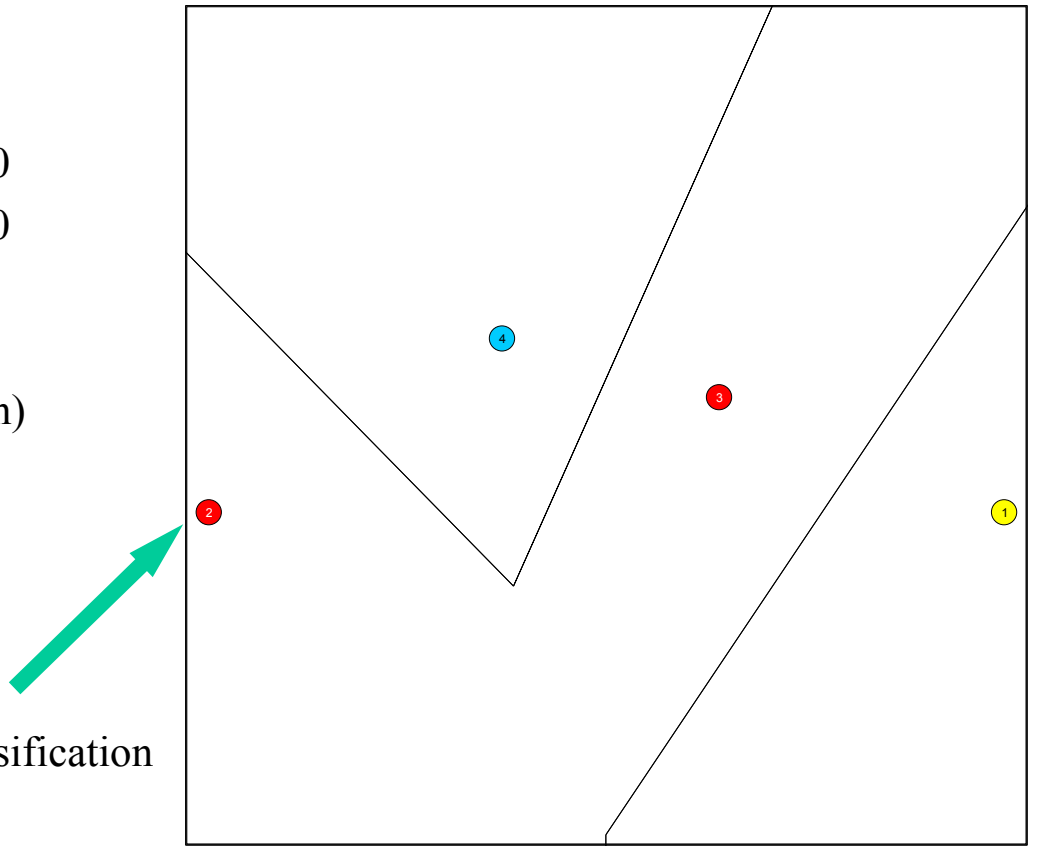
3. Classification

- Classification results: EAK

Test results:

Klasse1 (2): 0 (R) 50 50
Klasse2 (2): 0 (R) 50 50

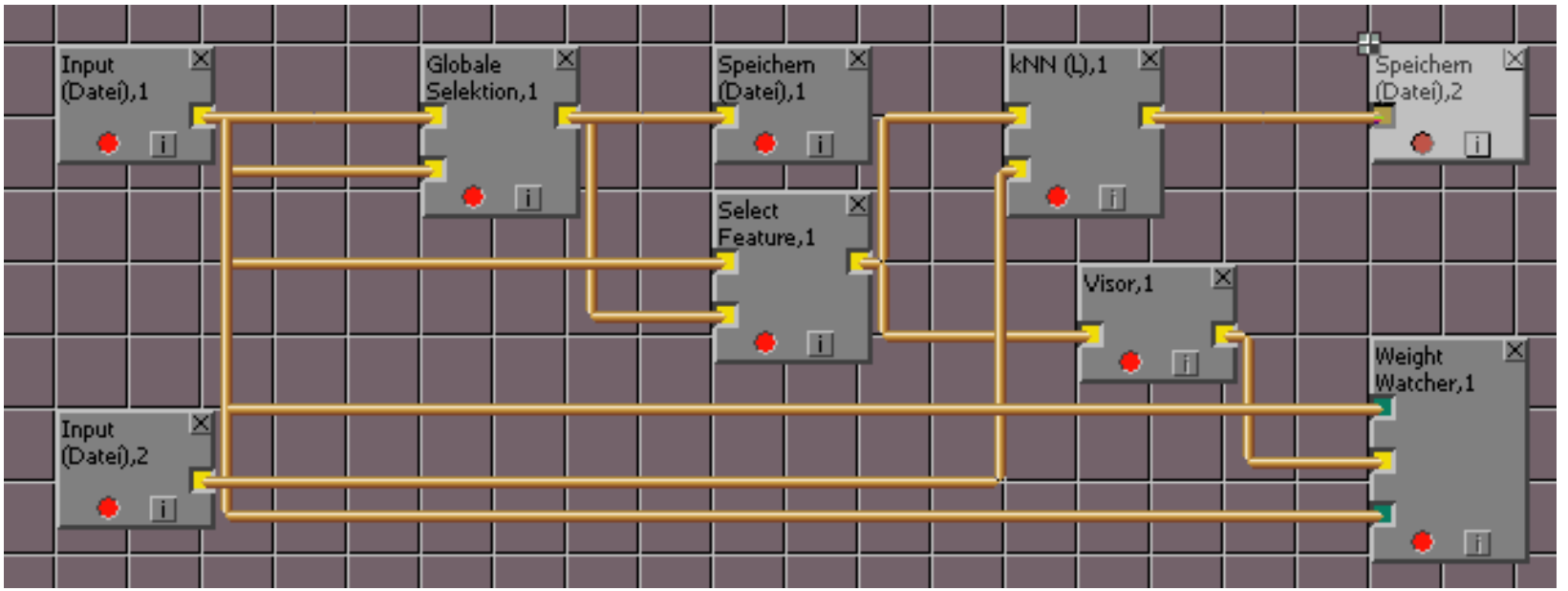
Erkennungsrate: 50.000 %
keine Fehler, 0 Warnung(en)



Red color means: failure of classification

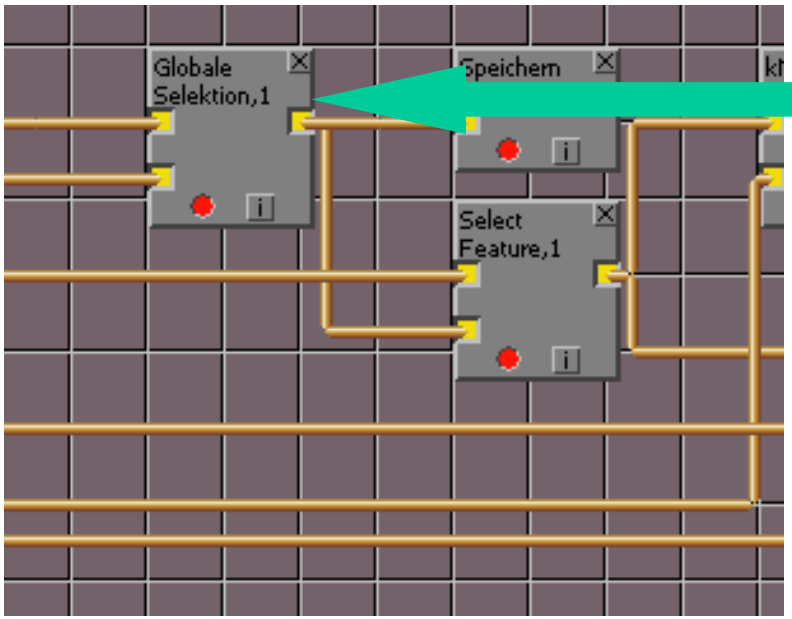
3. Classification

Train system with feature reduction



3. Classification

Train system with feature reduction

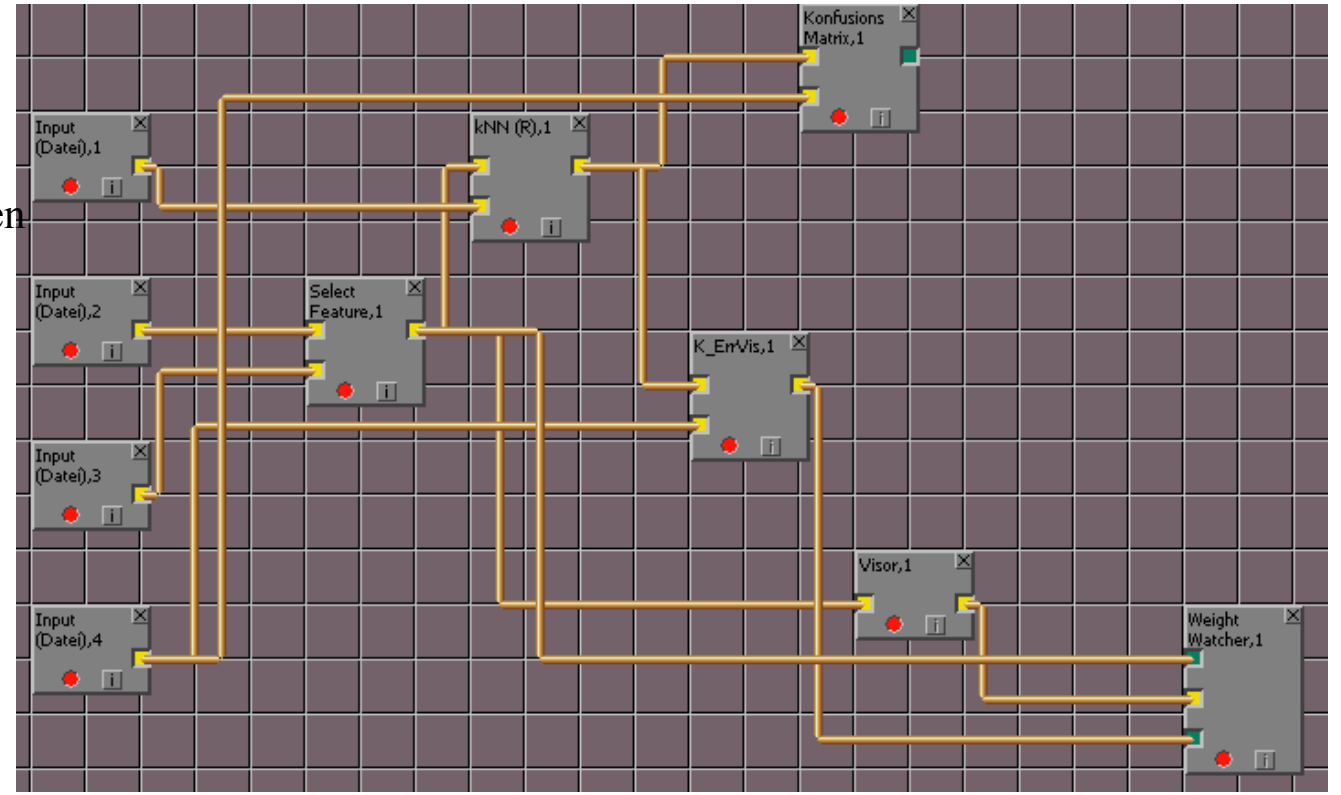


Different feature reduction methods can be chose

3. Classification

Test system without feature reduction

The list of features
hich have been chosen

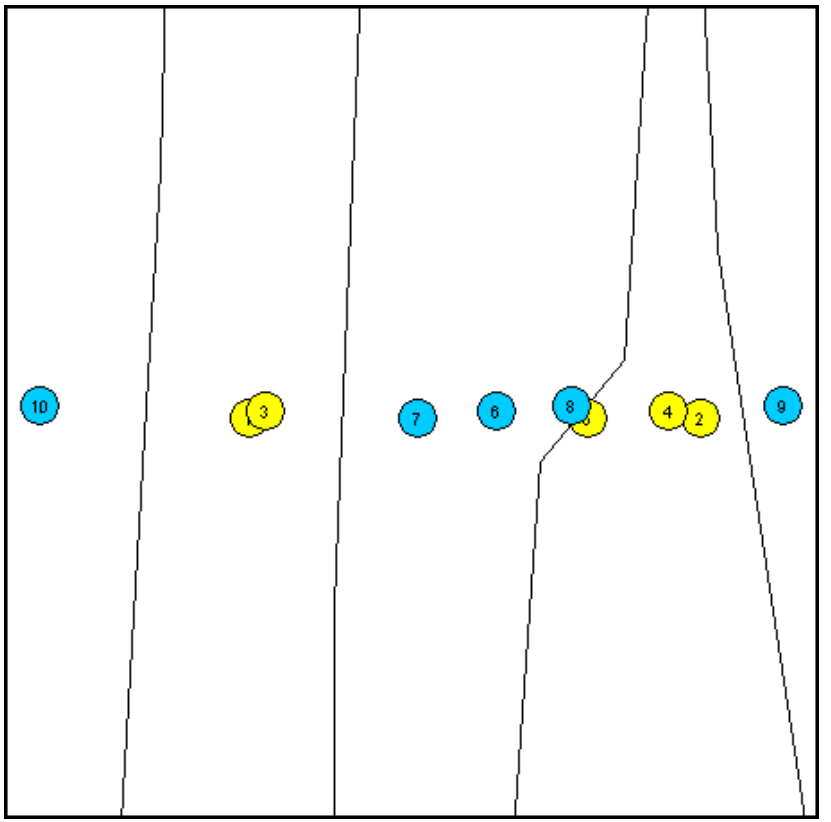


3. Classification

- Classification results: KNN, RNN, EAK

FeatureSelection Results:

Search Strategy: SBS
Quality Measure: qs
1 2 3 4 : 0.40000
- 2 3 4 : 0.50000
- 2 - 4 : 0.60000
- 2 - - : 0.60000
Best Quality: 0.60000
Best Features: 2
no error(s), 0 warning(s)



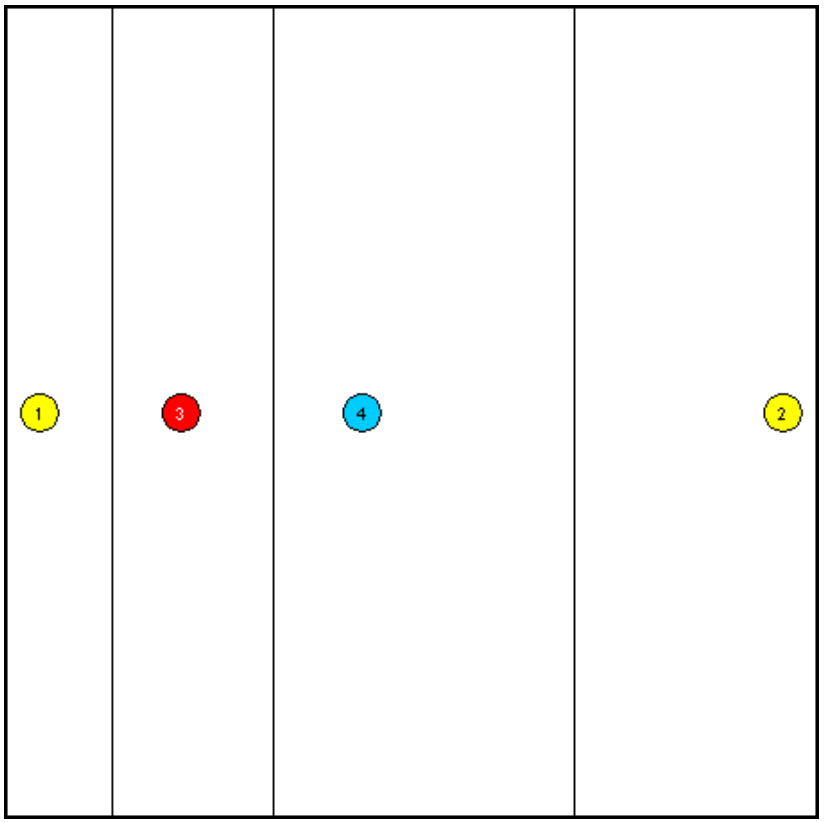
3. Classification

- Classification results: KNN, RNN

Test results:

Konfusions Matrix,1
Klassifikationsresultate:
Klasse1 (2): 0 (R) 100 0
Klasse2 (2): 0 (R) 50 50

Erkennungsrate: 75.000 %
no error(s), 0 warning(s)



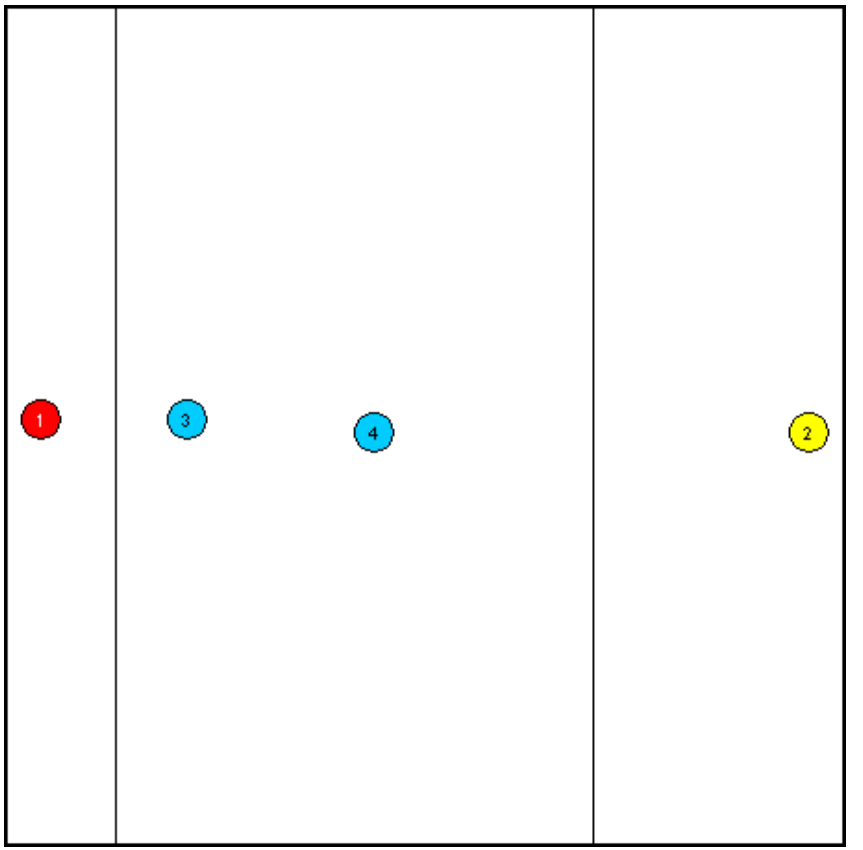
3. Classification

- Classification results: EAK

Test results:

Konfusions Matrix,1
Klassifikationsresultate:
Klasse1 (2): 0 (R) 50 50
Klasse2 (2): 0 (R) 0 100

Erkennungsrate: 75.000 %
no error(s), 0 warning(s)



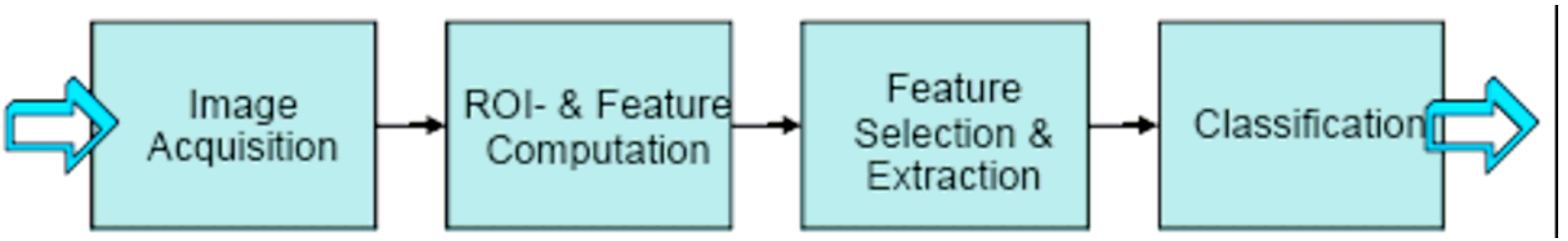
3. Classification

- Results

Feature Reduction	Method of Classification		
	KNN	RNN	EAK
Without	100% classified	100% classified	50% classified
With	75% classified	75% classified	75% classified

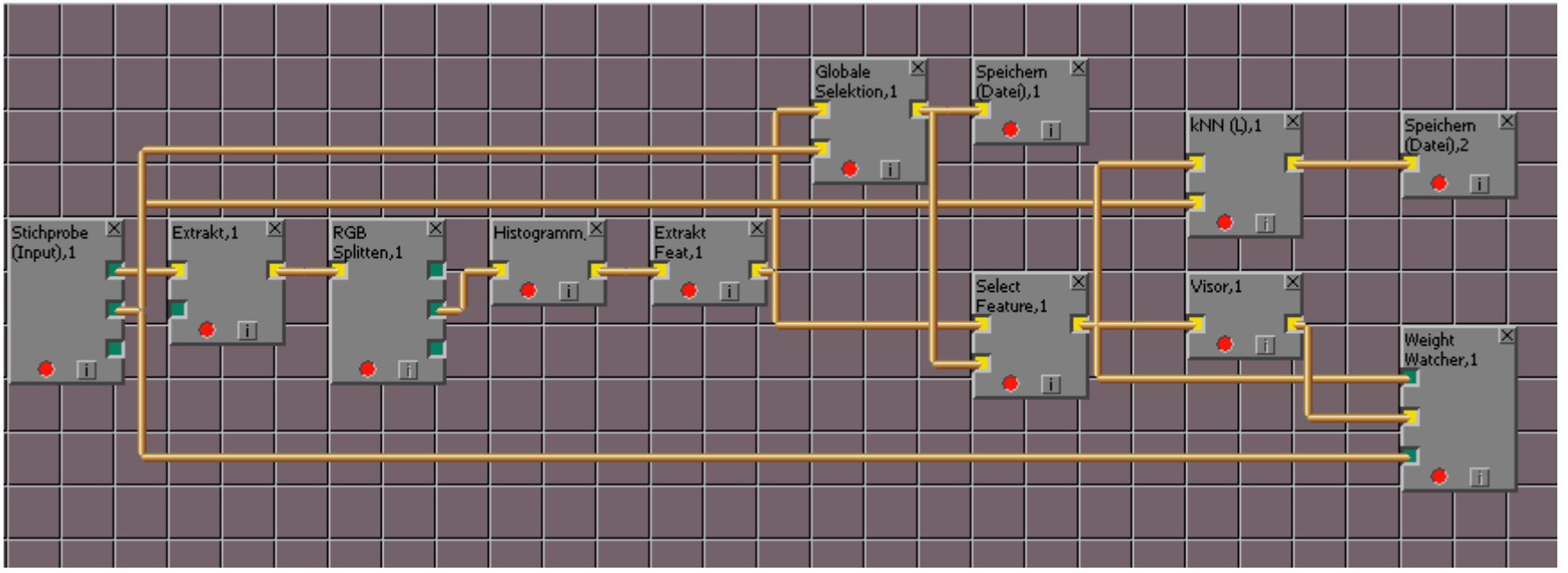
4.Recognition System Using RGB Histogram

- A recognition system which is entirely basic on the Quickog image processing is discussed in this part, the structure of the project is shown below



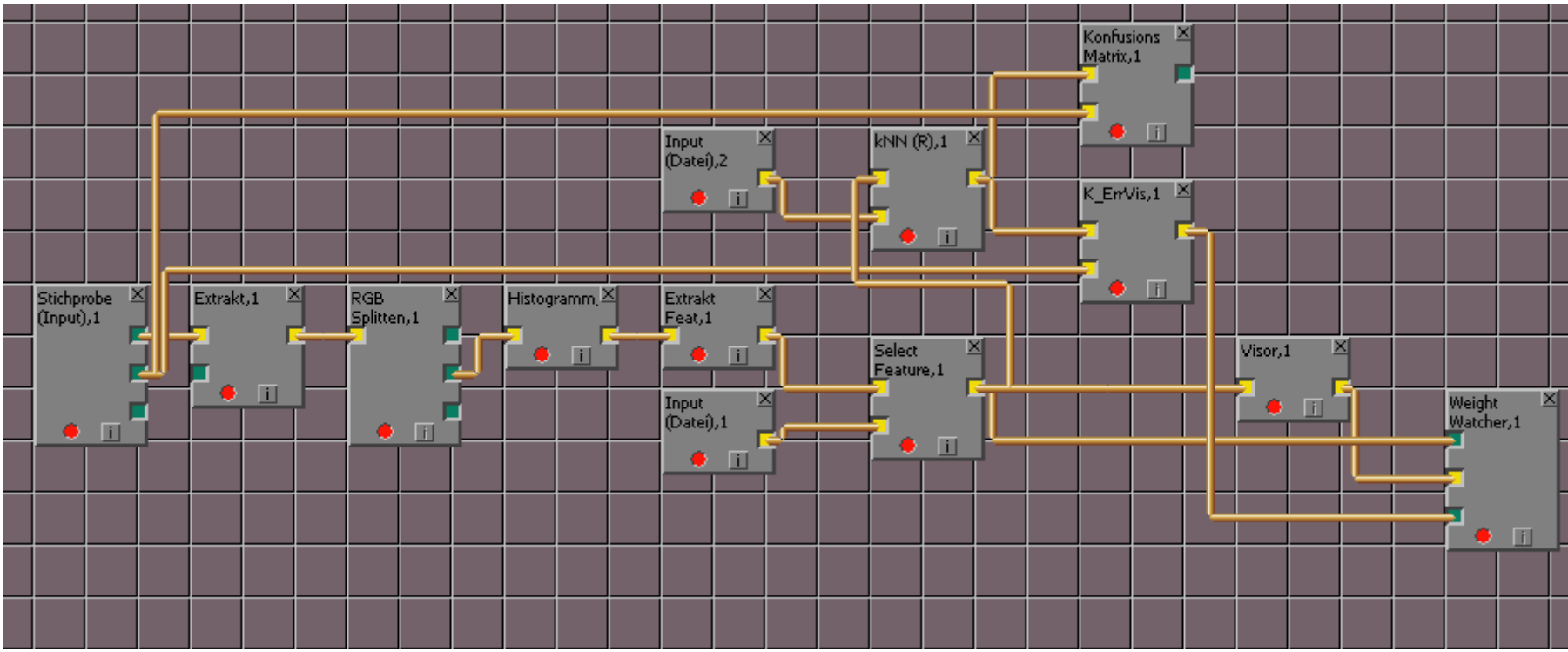
4.Recognition System Using RGB Histogram

- Project: train system



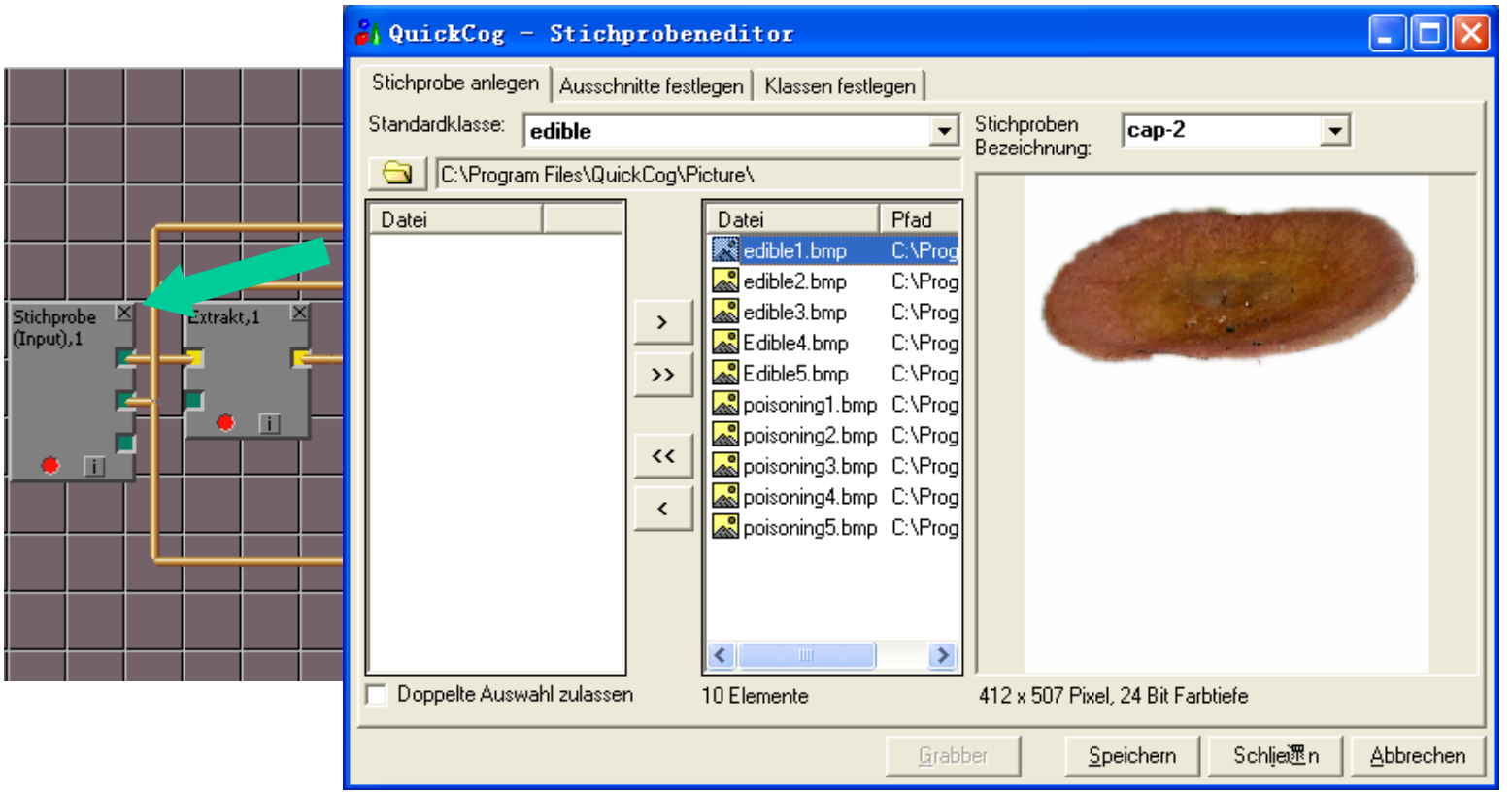
4.Recognition System Using RGB Histogram

- Project: test system



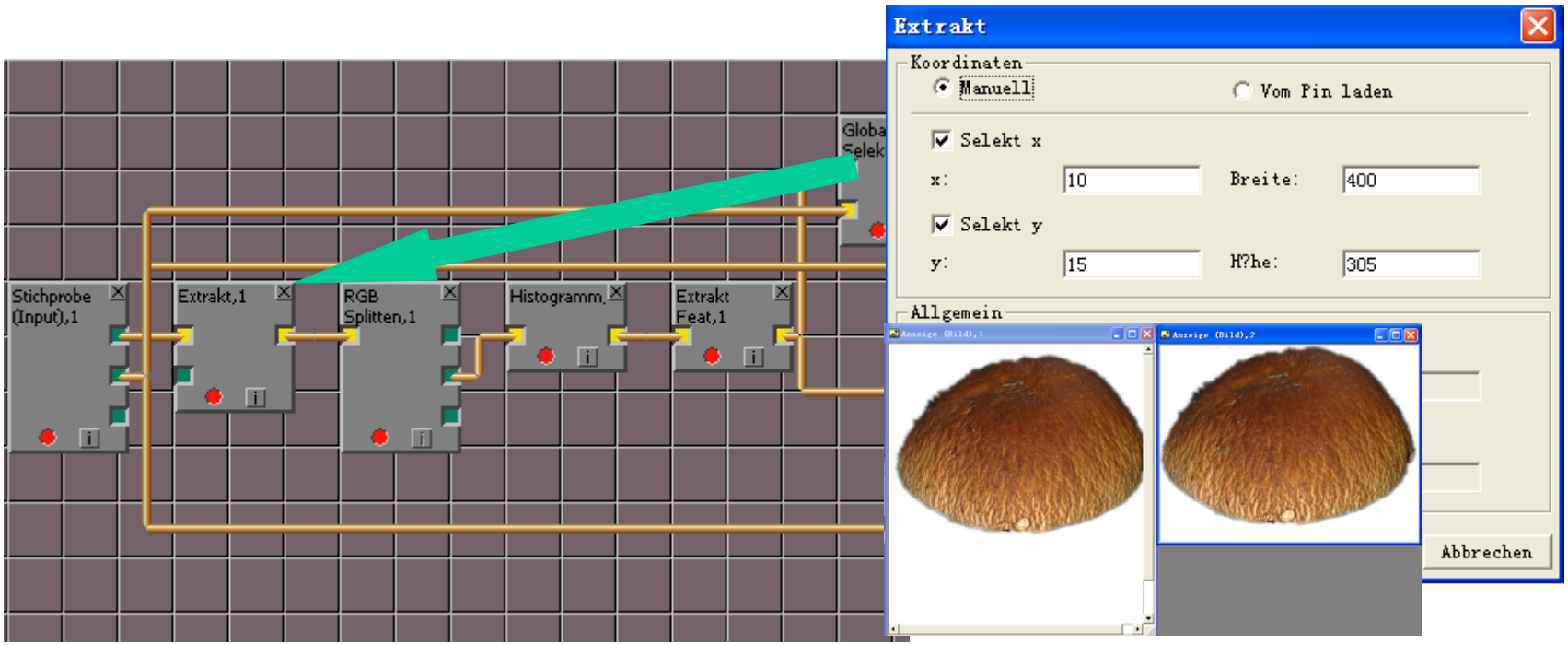
4.Recognition System Using RGB Histogram

- Image Acquisition



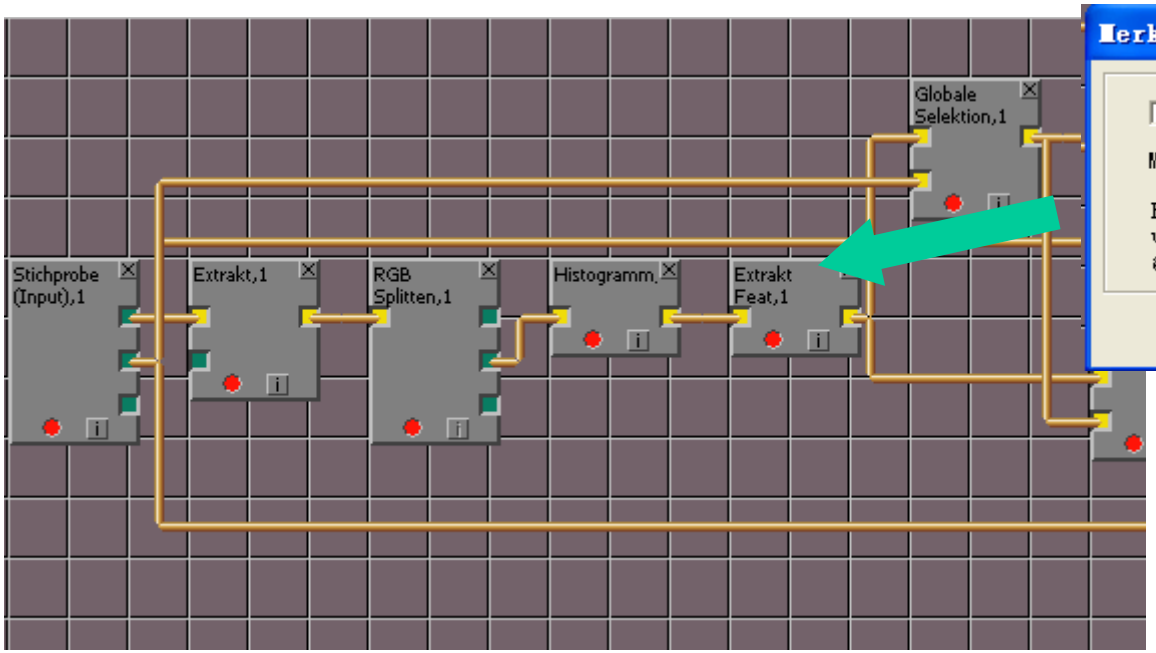
4.Recognition System Using RGB Histogram

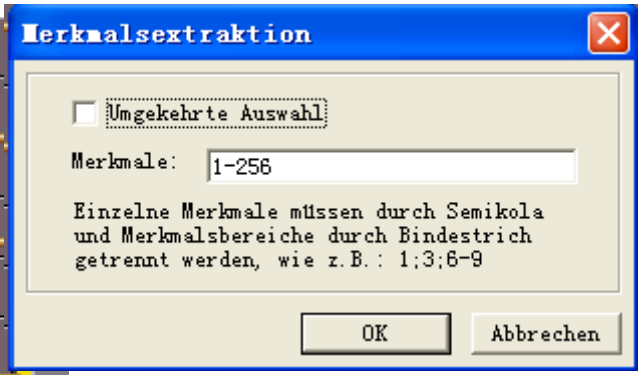
- After data aquisition, one “Extrakt.1” block is used to extract ROI part, the cap area of the mushroom.



4.Recognition System Using RGB Histogram

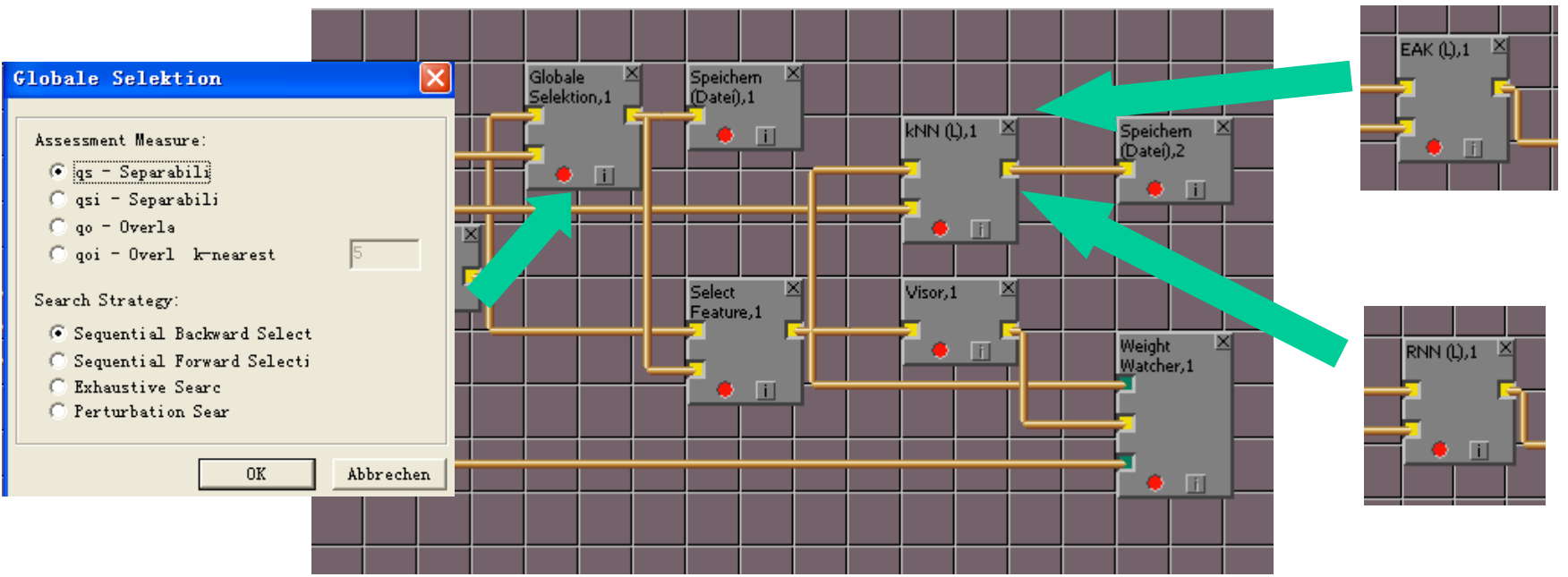
- Original colorful pictures are divided into RGB image data after ‘RGB splitten’ block and through the “Extract Feat” block, the best range of features can be found.





4.Recognition System Using RGB Histogram

- After RGB channels (green:10-220) and feature extraction, dimension reduction method and different classification methods are also tested to find the best classification results.



Results

Color	global selection	classification method	best quality	numbers of features	result
Green (10-220)	qs-separability	KNN	0.8	3	100%
	qs-separability	RNN	0.8	3	75%
	qs-separability	EAK	0.8	3	75%
	qsi-separability	KNN	0.8	4	100%
	qsi-separability	RNN	0.8	4	50%
	qsi-separability	EAK	0.8	4	50%

Results

Color	global selection	classification method	best quality	numbers of features	result
Green (10-220)	qo overlap qoi overlap k=5	KNN	0.60591	14	100%
	qo overlap qoi overlap k=5	RNN	0.60591	14	75%
	qo overlap qoi overlap k=5	EAK	0.60591	14	75%

- Based on the results above, we can see that the RGB histogram recognition system works well with KNN classification methods under all 4 kinds of feature reduction method

Further work

- The efficiency and recognition capability of the system are mainly dependent on the size of data set. Lager data set , that means more ac--curacy. It is the one of important points which can improve this sys--tem.
- In the above system, object ratio between height and width, and color feature are considered and used as the mushroom property for classification, Another feature which can be also considered is texture in the cap of the mushroom.
- More classification methods should be utilized for this system.

Conclusion

What have I learned from this project?

- For research work, there is no one method which will always work and be available for any problem. Different methods must be considered, tested and combined to find a sufficient results,.
- Capability to use Matlab and Quikcog to deal with image processing p-roblem, and experience of establishment of a simple recognition system.
- In an image processing application, color, size and texture is usually c-onsidered to analysis the object.
- Understanding the classification method with Euclidean distance.

Reference

Image source:

Edible:

http://s268.photobucket.com/albums/jj29/ultimategod406/?action=view&current=LargeBrownMushroom.jpg&newest

Poisoning:

http://www.truongxua.vn/Members/MemberPhoto.aspx?page=5&memberid=410417

http://aaaaahhhhshark.wordpress.com/2009/09/10/mushrooms-bats-and-badgers-oh-my/

http://deemix.wordpress.com/2007/12/25/whats-the-coolest-sounding-thing-you-cant-eat/

http://www.truongxua.vn/Members/MemberPhotoDetail.aspx?memberid=410417&id=401796

www.poisoncentertampa.org/

Test:

blog.americanfeast.com/sustainable_food/

http://aviary.com/artists/kayjaycali@msn.com/creations/amanita_mushroom1

Thank You!